

THERMAL STABILITY

Purpose:

This experiment will help students observe and understand the phenomenon of thermal alteration.

Concepts:

1. A sudden temperature increase is sufficient to dewater clay, but depending on the interlayer cation, the physical responses of the clays are significantly different.
2. Some of the repository minerals most susceptible to thermal alteration are the same minerals responsible for sorption characteristics important to repository performance.

Duration of Lesson:

One-and-one-half 50-minute class periods (See item 3 in suggested procedure section.)

Objectives:

As a result of participation in the lesson entitled *Thermal Alteration*, the learner will be able to:

1. discuss the range of response by one clay mineral to a sudden temperature increase; and
2. explain why an understanding of how heat may affect a rock is important in planning for a geologic repository.

Skills:

Hypothesizing, measuring, observing, recording data, working in groups

Vocabulary:

Dehydration, exfoliation, vermiculite

Materials:

Activity Sheets

Thermal Stability, p. 201

Background Notes

Thermal Stability, p. 65

Videotape

Science, Society, and America's Nuclear Waste Teleconference Videotapes (available free of charge from the OCRWM National Information Center, 1-800-225-6972; within Washington, DC, 202-488-6720)

Other

flake vermiculite
saturated KCL solution (table salt substitute)
2 aluminum pans (or oven-safe containers)
candles
drying oven
pot holder
two 250 mL beakers

Suggested Procedure:

1. Before students begin this activity it may be wise to review the concepts of ions, hydrated ions, and ion exchange. The only difference between the two clays used in this activity is the exchangeable cation. See the attached *Background Note* for a discussion which may be useful in preparing a background lecture.
2. The activity requires several heat sources. One is an oven for slowly drying the two clay samples. This oven should be able to maintain a constant temperature of 110 °C (225 °F) (+ or - 50). The second heat source must provide a rapid means for boiling the interlayer water. This entails a rapid and large temperature increase such as that provided by a candle, Bunsen burner, or the broiler element in a toaster oven. Alternatively, a microwave oven selectively heats the water molecules to boiling and produces the same effect.
3. Making the potassium saturated vermiculite and oven drying the two clay samples may require starting the activity on one day and completing it the following day.
4. You may wish to discuss the reasons for using the Mg-saturated clay sample. The behavior of the untreated sample is used to compare against the other sample of vermiculite. Students should understand the importance of controls in any scientific experiment.

Teacher Evaluation of Learner Performance:

Student participation in experiment/activity will indicate understanding.